C L A I M S

1. A short range radar comprising:

a transmitter section which radiates a short range wave to a space;

a receiver section having a detector circuit composed of a branch circuit which receives a reflection wave of the short range wave radiated to the space by means of the transmitter section and branches in phase a signal of the reflection wave into first and second signals, a linear multiplier which linearly multiplies the first and second signals branched in phase by means of the branch circuit, and a low pass filter which samples a baseband component from an output signal from the linear multiplier;

a signal processor section which carries out an analyzing process of an object which exists in the space based on an output from the receiver section; and

a control section which makes a predetermined control with respect to at least one of the transmitter section and the receiver section based on an analysis result from the signal processor section.

2. The short range radar according to claim 1, characterized in that the linear multiplier of the detector circuit is composed of a Gilbert mixer.

3. The short range radar according to claim 1, characterized in that the receiver section has a sample hold circuit which carries out integration with respect

to an output signal of the detector circuit and holds and outputs a result of the integration.

4. The short range radar according to claim 3, characterized in that the control section variably controls an integration start timing and an integration time of the sample hold circuit of the receiver section based on a processing result from the signal processor section.

5. The short range radar according to claim 3, characterized in that a plurality of sample hold circuits are provided as the sample hold circuit, and the plurality of sample hold circuits each carry out integration in different periods from each other with respect to the output signal from the detector circuit.

6. The short range radar according to claim 1, characterized in that

a power amplifier which amplifies the short range wave is provided at the transmitter section,

a low noise amplifier which amplifies a signal of the reflection wave is provided at the receiver section, and

the control section controls a gain of at least one of the power amplifier provided at the transmitter section and the low noise amplifier provided at the receiver section so that a signal level of the reflection wave inputted to the detector circuit of the receiver section is within a linear operation range of

the linear multiplier.

7. The short range radar according to claim 1, characterized in that the transmitter section is provided with: a pulse generator which generates a pulse signal having a predetermined width; and an oscillator which operates to oscillate only in a period in which the pulse signal from the pulse generator is inputted and outputs an output signal as the short range wave, and stops the oscillating operation in a period in which the pulse signal is not inputted.

8. The short range radar according to claim 1, characterized in that the control section stops power supply to the transmitter section in a period in which the transmitter section radiates the short range wave to the space, and radiates a next short range wave to the space.

9. The short range radar according to claim 1, characterized in that the control section stops power supply to the receiver section in a period in which the transmitter section radiates the short range wave to the space, and then, radiates a next short range wave to the space except a period in which a signal of a reflection wave relevant to the short range wave radiated to the space is received by means of the receiver section.

10. The short range radar according to claim 1, characterized in that first and second receiver

sections are provided as the receiver section, each of which has first and second receiving antennas provided to be spaced from each other with a predetermined distance in order to receive the reflection wave, and

the signal processor section analyzes a direction of an object which exists in the space based on output signals from the first and second receiver sections.

11. The short range radar according to claim 2, characterized in that the Gilbert mixer used as the linear multiplier of the detector circuit comprises:

a first differential amplifier comprising first and second transistors each having a base input end, a collector output end, and an emitter common current path, the emitter common current path of the first and second transistors being connected to a constant current source;

a second differential amplifier comprising third and fourth transistors each having a base input end, a collector output end, and an emitter common current path, the emitter common current path of the third and fourth transistors being connected to a collector output end of the first transistor of the first differential amplifier;

a third differential amplifier comprising fifth and sixth transistors each having a base input end, a collector output end, and an emitter common current path, the base input end of the fifth transistor being

connected in common to the base input end of the fourth transistor of the second differential amplifier, the emitter common current path of the fifth and sixth transistors being connected to a collector output end of the second transistor of the first differential amplifier;

a first load resistor and a first output end connected in common to a collector output end of the third transistor of the second differential amplifier and a collector output end of the fifth transistor of the third differential amplifier, respectively;

a second load resistor and a second output end connected in common to a collector output end of the fourth transistor of the second differential amplifier and a collector output end of the sixth transistor of the third differential amplifier, respectively;

a first low pass filter including first and second coils and a first resistor and a second low pass filter including third and fourth coils and a second resistor connected in series, respectively, between a first pair of lines and an earth line which transmits the first signal branched in phase by means of the branch circuit;

a third low pass filter including fifth and sixth coils and a third resistor and a fourth low pass filter including seventh and eighth coils and a fourth resistor connected in series, respectively, between a

second pair of lines and an earth line which transmits the second signal branched in phase by means of the branch circuit;

first and second emitter follower circuits comprising seventh and eighth transistors each having a base input end and an emitter output end, the base input ends of the seventh and eighth transistors each being connected to each of connecting neutral points of the first and second coils and the third and fourth coils as each of the output ends of the first and second low pass filters;

third and fourth emitter follower circuits comprising ninth and tenth transistors each having a base input end and an emitter output end, the base input ends of the ninth and tenth transistors each being connected to each of connecting neutral points of the fifth and sixth coils and the seventh and eighth coils as each of the output ends of the third and fourth low pass filters;

a fifth low pass filter composed of: a ninth coil connected between a common collector output end of the third transistor of the second differential amplifier and the fifth transistor of the third differential amplifier and the first load resistor; a tenth coil connected between the common collector output end of the third transistor of the second differential amplifier and the fifth transistor of the third

differential amplifier and the first output end; and the first load resistor; and

a sixth low pass filter composed of: an eleventh coil connected between a common collector output end of the fourth transistor of the second differential amplifier and the sixth transistor of the third differential amplifier and the second load resistor; a twelfth coil connected between a common collector output end of the fourth transistor of the second differential amplifier and the sixth transistor of the third differential amplifier and the second output end; and the second load resistor, wherein

each of the base input ends of the first and second transistors of the first differential amplifier is connected to each of the output ends of the first and second emitter follower circuits, respectively, and thereby the first signal branched in phase by means of the branch circuit is inputted to the first differential amplifier; and

each of the base input ends of the third transistor of the second differential amplifier and the sixth transistor of the third differential amplifier is connected to each of the output ends of the third and fourth emitter follower circuits, respectively, and thereby the second signal branched in phase by means of the branch circuit is inputted to the second and third differential amplifiers, and thereby a linearly

multiplied outputs of the first and second signals can be led out from at least one of the first and second output ends.

12. A short range radar controlling method comprising the steps of:

preparing a transmitter section, a receiver section, and a linear multiplier;

radiating a short range wave to a space by means of the transmitter section;

receiving a reflection wave of the short range wave radiated to the space by means of the receiver section to branch in phase a signal of the reflection wave into first and second signals;

linearly multiplying the first and second signals by means of the linear multiplier to output a linearly multiplied signal;

sampling a baseband component from an output signal of the linear multiplier;

carrying out an analyzing process of an object which exists in the space based on the baseband component; and

making a predetermined control with respect to at least one of the transmitter section and the receiver section based on a result of the analyzing process.

13. The short range radar controlling method according to claim 12, characterized in that the step of outputting the linearly multiplied signal comprises

the step of carrying out linear multiplication for outputting the linearly multiplied signal by using a Gilbert mixer as the linear multiplier.

14. The short range radar controlling method according to claim 12, characterized by further comprising the step of, before the step of carrying out the analyzing process, carrying out integration with respect to the baseband component and holding and outputting a result of the integration.

15. The short range radar controlling method according to claim 14, characterized in that the step of carrying out integration with respect to the baseband component comprises the step of variably controlling a start timing of integration and an integration time with respect to the baseband component based on the result of the analyzing process.

16. The short range radar controlling method according to claim 14, characterized in that the step of carrying out integration with respect to the baseband component comprises the step of carrying out integration in a plurality of periods different from each other with respect to the baseband component by using a plurality of sample hold circuits.

17. The short range radar controlling method according to claim 12, characterized in that

a power amplifier which amplifies the short range wave is provided at the transmitter section,

a low noise amplifier which amplifies a signal of the reflection wave is provided at the receiver section, and

the step of making the predetermined control comprises a step of controlling a gain of at least one of the power amplifier provided at the transmitter section and the low noise amplifier provided at the receiver section so that a signal level of the reflection wave at the receiver section is within a linear operation range of the linear multiplier.

18. The short range radar controlling method according to claim 12, characterized in that the step of radiating a short range wave to a space by means of the transmitter section comprises the steps of:

generating a pulse signal having a predetermined width;

making an oscillation operation only in a period in which the pulse signal is inputted to output an output signal as the short range wave; and

stopping an oscillation operation during a period in which the pulse signal is not inputted so as not to output an output signal as the short range wave.

19. The short pulse radar controlling method according to claim 12, characterized in that the step of making the predetermined control comprises the step of:

stopping power supply to the transmitter section

in a period in which the transmitter section radiates the short range wave to the space, and then, radiates a next short range wave to the space.

20. The short range radar controlling method according to claim 12, characterized in that the step of making the predetermined control comprises the step of;

stopping power supply to the receiver section in a period in which the transmitter section radiates the short range wave to the space, and then, radiates a next short range wave to the space except a period in which a signal of a reflection wave with respect to the short range wave radiated to the space is received by means of the receiver section.

21. The short range radar controlling method according to claim 12, characterized in that first and second receiver sections are provided as the receiver section, each of which has first and second receiving antennas provided to be spaced from each other with a predetermined distance in order to receive the reflection wave, and

the step of carrying out the analyzing process comprises the step of analyzing a direction of an object which exists in the space based on output signals from the first and second receiver sections.

22. The short range radar controlling method according to claim 12, characterized in that, in the

step of outputting the linearly multiplied signal, the Gilbert mixer used as the linear multiplier comprises:

a first differential amplifier comprising first and second transistors each having a base input end, a collector output end, and an emitter common current path, the emitter common current path of the first and second transistors being connected to a constant current source;

a second differential amplifier comprising third and fourth transistors each having a base input end, a collector output end, and an emitter common current path, the emitter common current path of the third and fourth transistors being connected to a collector output end of the first transistor of the first differential amplifier;

a third differential amplifier comprising fifth and sixth transistors each having a base input end, a collector output end, and an emitter common current path, the base input end of the fifth transistor being connected in common to the base input end of the fourth transistor of the second differential amplifier, the emitter common current path of the fifth and sixth transistors being connected to a collector output end of the second transistor of the first differential amplifier;

a first load resistor and a first output end connected in common to a collector output end of the

third transistor of the second differential amplifier and a collector output end of the fifth transistor of the third differential amplifier, respectively;

a second load resistor and a second output end connected in common to a collector output end of the fourth transistor of the second differential amplifier and a collector output end of the sixth transistor of the third differential amplifier, respectively;

a first low pass filter including first and second coils and a first resistor and a second low pass filter including third and fourth coils and a second resistor connected in series, respectively, between a first pair of lines and an earth line which transmits the first signal branched in phase by means of the branch circuit;

a third low pass filter including fifth and sixth coils and a third resistor and a fourth low pass filter including seventh and eighth coils and a fourth resistor connected in series, respectively, between a second pair of lines and an earth line which transmits the second signal branched in phase by means of the branch circuit;

first and second emitter follower circuits comprising seventh and eighth transistors each having a base input end and an emitter output end, the base input ends of the seventh and eighth transistors each being connected to each of connecting neutral points of

the first and second coils and the third and fourth coils as each of the output ends of the first and second low pass filters;

third and fourth emitter follower circuits comprising ninth and tenth transistors each having a base input end and an emitter output end, the base input ends of the ninth and tenth transistors each being connected to each of connecting neutral points of the fifth and sixth coils and the seventh and eighth coils as each of the output ends of the third and fourth low pass filters;

a fifth low pass filter composed of: a ninth coil connected between a common collector output end of the third transistor of the second differential amplifier and the fifth transistor of the third differential amplifier and the first load resistor; a tenth coil connected between the common collector output end of the third transistor of the second differential amplifier and the fifth transistor of the third differential amplifier and the first output end; and the first load resistor; and

a sixth low pass filter composed of: an eleventh coil connected between a common collector output end of the fourth transistor of the second differential amplifier and the sixth transistor of the third differential amplifier and the second load resistor; a twelfth coil connected between the common collector

output end of the fourth transistor of the second differential amplifier and the sixth transistor of the third differential amplifier and the second output end; and the second load resistor, wherein

each of the base input ends of the first and second transistors of the first differential amplifier is connected to each of the output ends of the first and second emitter follower circuits, respectively, and thereby the first signal branched in phase by means of the branch circuit is inputted to the first differential amplifier,

each of the base input ends of the third transistor of the second differential amplifier and the sixth transistor of the third differential amplifier is connected to each of the output ends of the third and fourth emitter follower circuits, respectively, and thereby the second signal branched in phase by means of the branch circuit is inputted to the second and third differential amplifiers, and thereby a linearly multiplied outputs of the first and second signals can be led out from at least one of the first and second output ends.